RESEARCH PLAN PROPOSAL

Study on De- centralised Printing Cluster of Bagru, Jaipur and Its Impact on Soil and Aquatic Environment

For registration to the degree of
Doctor of Philosophy

IN THE FACULTY OF SCIENCE

THE IIS UNIVERSITY, JAIPUR

Submitted by

(Rena Mehta)
Enroll. No. ICG/2010/11503

Under the Supervision of

(Prof. Pradeep Bhatnagar)
Dean Faculty of Sciences

Department of Home Science

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INTRODUCTION

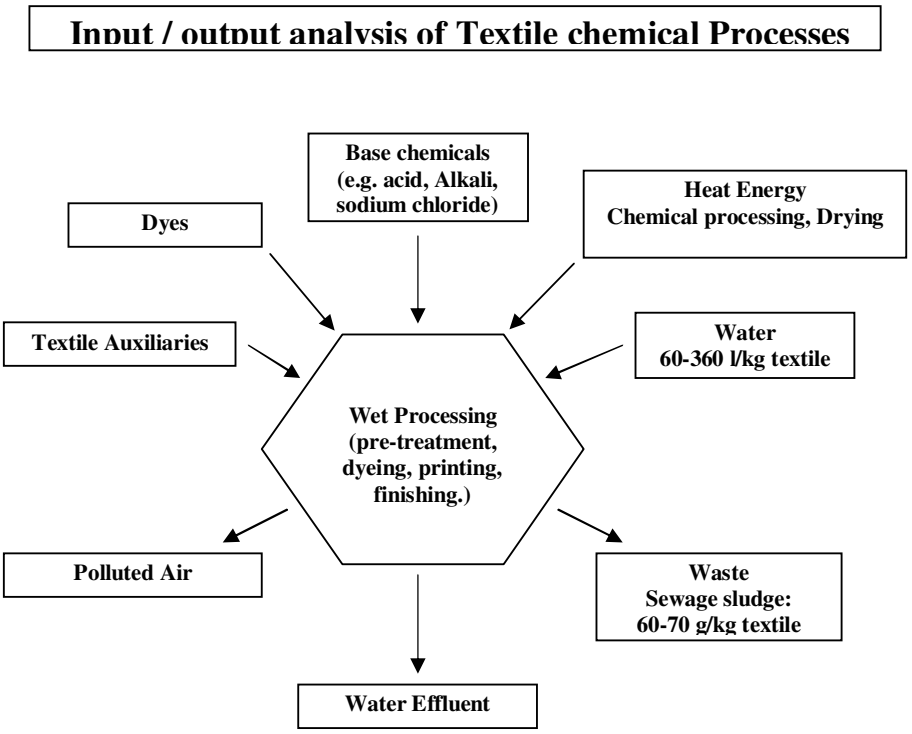
The history of emergence of textile printing in Rajasthan goes back to several centuries. Fabrics printed in Rajasthan were exported to various western countries and Japan. Even the East India company was exporting vegetable printed fabrics from Rajasthan in major quantities to various countries. It was during 18th century, the reign of Maharaja Jaisingh II, that Rajasthan experienced a great deal of cultural extravaganza. Traditional hand block printing was patronised to a great extent and flourished to many dimensions, during his rule. Various printing centres in Rajasthanare Barmer, Jaipur, Sikar, Jodhpur, Bikaner, Pali, Chittaurgarh, Udaipur, Nathdwara, Sanganer, Bagru, Kaladera, Bassi and Jairmapura.

Bagru is rural Indian village in Rajasthan is situated around 32 kms east of Jaipur city. Its traditional process of hand block printing on textile, with rich natural colors has been known for many centuries. This art is said to have started around 450 years back.The village had a community of *Chippas* who printed fabrics by hand. Bagru Chippas came from Sawai Madhopur, Alwar, Jhunjhunu and Sikar districts of Rajasthan

Natural dye and pigments are used in Bagru printing. Natural dyes can be sorted into three categories: those obtained from plants (indigo), those obtained from animals (cochineal), and those from minerals (ocher). The application of these dyes requires the use of mordant- a substance which aids the chemical reaction that takes between the dye and the fiber to foster dye penetration. Various types of mordents used in the natural dyes are –Alum *(Aluminium Potassium Phosphate),* Copper *(Copper Sulfate),*Chrome (*Potassium Dichromate),* Iron (*Ferrous Sulphate),* Glaubersalt (*Sodium Sulphate),* Spectralite (*Thiourea Dioxide),* Tara Power (*Caesalpinia Spinosa),* Tartaric Acid , Tin (*Stannous Chloride)* and Calcium Carbonate. Due to the use of pigments, Chemicals and the mordents trace quantities of metals such as lead (Pb), Chromium(Cr), Cadmium(Cd), Copper(Cu), Iron(Fe) etc are found in the waste water.

The textile industry has always been regarded as water intensive sector since it uses water as the principal medium for removing the impurities, application of dyes and finishing agents, and to generate steam. The main concern is therefore about the amount of water discharged and the chemical load it carries. The effluents contain highly toxic dyes, bleaching agents, salts, acids and alkalies. Pollution is the main accuse in the textile printing sector. The effluents discharged from the printing units

ground causes environmental pollution. The use of toxic chemicals in printing units causes threat to the flora and fauna. Further the untreated effluents are discharged in to the environment they can cause severe contamination of surface and ground water.


Input / output analysis of Textile chemical Processes
Base chemicals (e.g. acid, Alkali, sodium chloride)
Heat Energy Chemical processing, Drying
Dyes
Textile Auxiliaries
Water 60-360 l/kg textile
Wet Processing (pre-treatment, dyeing, printing, finishing.)
Polluted Air
Waste Sewage sludge: 60-70 g/kg textile
Water Effluent

Details of various Chemicals used in the printing and dyeing process:

Table no. 1 <u>Contribution of various contents to the environment</u>

S.No.	Processing operation	Chemicals	Content responsible
1	Scouring	Caustic soda, Tarkayan oil, Edible oil.	Starch, acids and alkali
2.	Bleaching	Bleaching powder Hypochlorite	Chlorine, Hypochlorite
3.	Harda	Tannic acid	Gallic acid, glucose esters
4.	Printing	Napthol dye	Azoic dye
5.	Dyeing	Alizarin	Kitone group
6.	After treatment	Alum	Na_2So_4

Most of the printing units being small scale hardly posses any kind of effluent treatment plant. Since, the treatment plant has high installation cost for controlling the toxicity due to the waste water produced by the printing units it becomes difficult for small-scale industries to adopt. Also these low investment companies do not have the budget to invest in protective clothing for their workers, which results in health problems. The environmental pollution caused by the textile effluents results in adverse effect on flora, fauna and general health of residents residing in the communities within and around the sites, and villages downstream.

Bagru is located in the south-west of Jaipur Region at a distance of about 30 Kms from Jaipur city on National Highway (NH-8) towards Ajmer. Dhami Kalan is included in Bagru town. The revenue area of the town with settlement is 41.65 sq.km.This town is located between North latitude 26°48'07"to 26°50'18" and East Longitude 75°32'07"to 75°34'06". The town is famous for its Dabu printing, in all there are 250 printing units. Printing is mainly carried out by the natural dyes but some enterprises make use of synthetic dyes.

Demography Population:

The population of Bagru town is 26,534 as per 2001 census as against the figure of 18,868 in 1991 thereby recording a growth rate of 40.63% for the decade 1991-2001. The total number of households is 3,654 with an average household size of 7.26.

PURPOSE OF THE STUDY

Dyes and auxiliary chemicals used in textile dyeing and printing are developed to be resistant to environmental influences. As a result, they are hard to remove from wastewater generated during the dyeing & printing processes. The best way to reduce the impact of these dyes and chemicals on the environment is by reducing the amount released for treatment in conjunction with the waste water treatment. The introduction of a more environmentally sound practices of work is however, hampered by many practical obstacles. Reduction of the colored components of the dyes can be done by using the microbes that are resistant to that environment and can use the dyes as a source of nutrient, resulting in dye decomposition. Having reviewed the available literature the investigator discovered a dearth of the database researches carried on such burning issues. Hence, there was a felt need of reliable records focusing on various aspects of printing units including the profile and the technical aspect, waste management procedures and health problems of the workers in these units. Its seminal significance lies in its presentation, exposition and evaluation of the present prevailing conditions in the printing units.

The main problem lies in the collection and assessment of the environmental data of textile printing sector along with a remedial measure, keeping all these views in mind the present study is planned.

OBJECTIVES

The study is instigated with the following objectives:

- To study the profile of the owners of printing units.
- To study the profile and technical aspects of the printing units.
- To observe the waste management procedures followed in the printing units.
- To investigate the physiochemical properties of effluents.
- To estimate the metal contamination in the surface waste water, ground water and contaminated soil.
- To investigate the microbial flora and fauna of the soil contaminated with the effluents of the printing units.

Review of Literature

Population explosion, haphazard rapid urbanization, industrial and technical expansion, energy utilization and waste generation from domestic and industrial sources have rendered many waters unwholesome and hazardous to man and other living resources. Also many industries discharge untreated and inadequately treated waste water into water ways (Amuda & Ibrahim, 2008). The textile waste water is rated as the most polluting among all industrial sectors considering both volume and composition of effluent (Vannelevinera,et.al 1998).

(Mehta 2006), studied the printing cluster of Jetpur the study focused on the occupational hazards and problems faced by the inhabitants residing in an around the screen-printing units of Jetpur. Purposive sampling method in conjugation with snowball technique was adopted to select the sample. The results highlighted the fact that detrimental work practices in the printing units without the use of protective clothing resulted in various types of physical, chemical, ergonomic and biological hazards. The major problems faced by the workers related to skin were itching, dry skin, cracks and pimple acne owing to the exposure of chemicals. Shoulder problems comprised of pain, stiffness, and tremors in hand and pain in elbow due to the activity performed and lower limb. Results also revealed that people residing near the units suffered from many physical problems such as headache, feeling of nausea and difficulty in breathing owing to the stagnant colored water and overflow of the drainage pipes from printing units.

The textile industries produce huge amount of polluted effluents that are normally discharged to surface water bodies & groundwater equifers. They consume substantial amount of water and chemicals. Further about 1000 different dyes and pigments are used (Zollinger 1987) Apart from chemicals nearly 10 to 15 percent of the dye is lost as effluent during dying process (Banat et. Al 1996)

These waste water cause many damage to the ecological system of the reviewing surface water. (Georgion, et al 2002, Coal, 2003) and create a lot of disturbance to the ground water resources. Major pollutants in textiles waste waters are high suspended solids, head colour & other soluble substances (Dal-hee.et.al.1999) because of high BOD, the untreated textile waste water can cause rapid depletion of DO it is directly discharged into surface water sources. Effluents with high levels of COD are toxic to biological life. (Metcaff & Eddy, 1991)

Textile dying industries contribute much to water and soiled pollution. Before start of any environmental impact study it is necessary to identify the baseline levels of relevant environmental parameters which are likely to be affected. Pollution of any water body is revealed by the various physic chemical and micro biological parameters.

Various studies were performed to moniter the physico chemical characteristic of textile industries (Mathur et.al 2006) reported low BOD and very high COD in water of Amanishah drainage which receive effluents from printing clusters situated at Sanganer, authors also studied season wise changes in the characterstics of the effluents. Some changes in the characteristic of effluents were also reported may be due to seasonal fluctuations which lead to mixing of deposited matter in the drainage.

Amani shah drainage water is also used to irrigate nearly agricultural fields. In some cases these effluents were found to be increasing the productivity of the vegetables irrigated by it but vegetables were not found to be suitable for consumption as presence of mutagems has been reported in their vegetables irrigated by this water. Consequently, there is a possibility that these genotoxicaty will enter the food chain and affect the larger population. Many research publications have reported on the genotoxicaty and toxic assessment of effluent of textile industries located around the amanishah drainage. (Mathur et.al 2005 and Usha 1989).

A report submitted by TIDE (2007) reported that surface water and sewage water are highly contaminated. The quality of ground water has also been deteriorated due to the discharge of disposal of effluents in CETP. On the contrary TDS, chloride, sulphate, oil and Greece are higher than permissible limits owing to accumulation of pollutants for years, also except for magnesium all parameters were higher than permissible limits attributable to uses of chemical in large amount. Small and medium enterprises of textile industries are discharging the untreated effluents into the environment (Mukherjee and Nelliyat, 2006) states that textile effluents have caused serious environmental impacts at the regional level. High alkalinity, chloride, EC, Iron, Phosphate, BODs and TDS values were reported in the water at Orthapalayam reservoir, Kerala.

The study also indicates that surface & ground water are unfit for irrigation purpose or for cultivation this inference of the result is obtained because pollution concentration of Noyall river is low till it reaches Tirrupur but it increases considerably as it reaches to Orthapalayam dam this is due to the textile Processing cluster at Tirrupur.

Improper handled & disposed industrial waste imperils both human health & the environment. Most of the coloured industrial waste including textiles (Mathur et.al 2005), paper & pulp (Klekoweki and Devin 2006) and dye based industries (Wells et.al 1994) have proved toxic & mutagenic to human beings (Zhurkon et.al 1998). Human exposures (occupational & non occupational) to industrial wastes have led to health effects ranging from headaches, nausea, lung & skin irritations, to serious ailments like congenital malformations (Shinka et.al, 1991; Morikawa et.al 1997) and cancer (Felton et.al 2002).

Effluent & sludge from the textile processing not only affects the soil but also interferes the life system of all living organisms (Mami Jothi 1989, Mohan 1972). The waste water discharges into the Noyall river stream had adversely affected the water quality, rendering the downstream water unsuitable for drinking, irrigation (Mahapatra et.al 1990). Also the discharge of effluents into river increases the BOD & COD of the Noyall river water (Verma et.al 1974). The presence of Hydrogen Sulphide, NH4 & chloride in textile mills effluents are highly toxic to water bodies (Mishra et.al 1990).

Apart from river water, the pollutants of underground water due to disposal of waste water into river are unfit for use of domestic purpose (Ramaswamy et.al 1991) and similar is the case of water on open land (Rastogi et.al 1990 and Vihage 1993). Effluents used for irrigation soil PH, Organic C, NPK, Ca, Mg & Na content (Soma et.al 1994). Productivity of the crops in greatly hindered owing to the textile effluents (Rajannan 1990)

Balakrishnan et. Al 2008 concluded that groundwater in Kancheepuram area is fair for drinking & irrigation purposes in spite of the effluent discharges from the textile processing units. Whereas, indicated a presence of Hg, Ar, Pb & Cr beyond the permissible limits given by WHO standards that pose significant threat to the consumer.

Many dyes, imparting colour to the effluents have been proved to be mutagenic (Chung & Cerniglia 1992, Mathur et.al 2005). Thus effluents colour reflects the possibility of mutagens present in it. Besides the problem of colour some dyes are toxic & can be modified biologically to toxic compounds.

Many of the studies on biological processes for the treatment of dye house effluent are in the stage of development. Generally studies are carried out using only a single non-commercial synthetic dye (Knapp 1999, shahvali et.al 2000, Jain et.al 2001 & Coughlin et.al 2002)

Singh and Thakur 2004 reported the removal of colour & detoxification of pulp & paper mill effluent by micro organism in two step bioreactor. P*aeciloymces* species exhibited significant reduction in phenol, lignin, COD & colour. However fungal treated effluent was subsequently treated by bacterial stream M*icrobrevis lutum* showed reduction in phenol, colour, COD & lignin.

Fungal diversity was studied by Shasarabudhu (2005) and reported that the fungal species were degrading the surrounding substrata i.e. the substances that are considered as waste from the Textile industry mainly cellulose fibers. (Selveray 2003) studied the occurance of VAM fungi in the industrially polluted soils & reported that that in all the three sites G*lomus faceculatum* in particular was predominant colonizing species. Impact of dying the printing industrial effluents on soil were found to have a fair absorbing capacity of organic & metallic pollutants (Ratel & Srivastav 1999)

Heavy metal contamination occurs in aqueous waste of many industries such as electroplating industries, paint industries, textile manufacturing industries, leather tanning industries, iron and steel industries and metal finishing industries etc and ultimately disposed to land or in to water courses. Hence water has to be treated to prevent any injury to aquatic life on receiving water. (Vasanthy et.al 2006) Metals in textile industrial effluent are produced during dyeing process, which usually contributes chromium, lead, zinc and copper to wastewater. Although heavy metals may be discharged in highly diluted form but these can reach to human beings in a concentrated form through simple food chain, with much bio-magnification, if are absorbed and retained by plants or animals. Heavy metals produce undesirable effects and toxicity even if they are present in extremely minute quantities, on human and animals' life4. Since most of the heavy metals are non-degradable into non-toxic end-products, therefore their concentrations must be reduced to acceptable levels before discharging them into the environment.

Deepali et.al 2009 studied the heavy metal concentrations in untreated and treated samples of textile industry effluent in Bahadarabad, Hardwar. It revealed that the chromium concentration found to have increased from the recommended norms1 of textile effluent discharged on ground while the concentration of Cd, Fe, Mn and Cu were found with in the prescribed limits. The values of metals namely Cr, Cd, Fe, Mn and Cu were noted to decrease by 78.43%, 66.66%, 54.11%, 39.82% and 100%, respectively, after treatment, than untreated effluent samples.

METHODOLOGY

In order to get deeper understanding and acquaintance to the topic extensive information will be congregated from primary and secondary sources of information..

The investigator will adopt survey coupled with observation technique to procure the data for conducting the present study. Experimental work for Microbial, Physicochemical and metal analysis will be carried out according to the APHA manual standards. The study is planned out in two phases and the methodology used for the study has been discussed under the following heads.The study will be carried out in two phases.

Phase I

Cluster study comprises of the details regarding Infrastructure, Processing, Workers Profile and Waste management procedure in the printing units.

Phase II

Physiochemical and microbial characterization of the effluents and contaminated soil.

Monitoring of metals in effluents, contaminated soil and ground water.

1. Selection of Sample

Phase I : To gain a holistic insight into the functioning and existing status of textile printing units of Bagru, purposive random sampling technique will be adopted for the present investigation in order to select the respondents. It is inevitable to restrict the survey to a manageable number of sample units on account of practical considerations such as time and resource constraints hence 50 units of the total number of units will be selected as the sample size.

Phase II: Sampling site for the determination of the physico- chemical parameters, metal toxicity and microbial study sample of liquid and solid effluents will be collected in the following manner:

Liquid samples- Effluent from the units, surface water and ground water will be analyzed for the following Physicochemical parameters pH, BOD, COD, DO, TSS, TDS and metals like Fe,Pb, Cu, Cd.

Soil Sample: soil sample from immediate dumping site of effluent and agricultural fields which are irrigated with the effluent contaminated water will be analyzed for the following physicochemical parameters Alkalinity, Organic Carbon, Nitrogen, Calcium, Magnesium, Potassium and Moisture content and metals like Fe, Pb, Cu, Cd and microbes.

For control study water and soil samples from uncontaminated sites i.e. seven to eight kilometres apart from the industrial area will be selected to study the above parameters.

2. Collection of Samples

To assess the pollution load caused due to printing, samples will be collected from the industrial site and the agricultural land. Samples for the solid and liquid waste will be collected in the months of April, August and December covering the three seasons (summers, winters, and rainy) seasons.

3. Tools and Techniques of Data collection

Phase I: A multi-visit approach will be adopted to elicit the necessary information. The data will be collected using structured interview schedule, and participant observation method.

Development of interview schedule: based on the objective the interview schedule will comprise of the following

- Profile of owners
- Profile and technical information of the units.
- Waste management procedures practiced within the printing units

Phase II: For the estimation of the of the Phase II parameters experiments will be carried out as per APHA manual standards.

4. Analysis of Data

Analysis of data will be broadly categorized as:

a) Processing of data

- Coding
- Tabulating

The data collected from the respondents will be systematically coded and tabulated.

b) Presentation of data

- Percentages
- Frequencies
- Tables
- Pie-charts
- Photo plates
- Flow charts
- Graphical presentation
- Descriptive analysis

Statistical analysis will be carried out for the experimental work.

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